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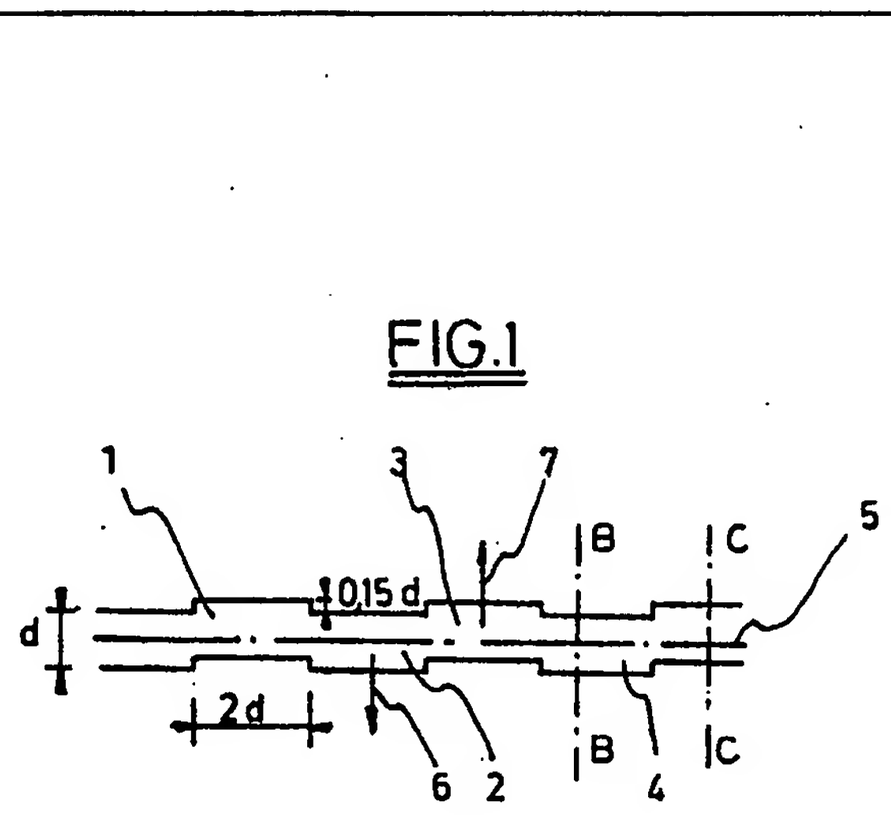
(54) Steel wire element for reinforcing mortar or concrete

(57) A steel wire element for reinforcing mortar or concrete, having a length in the range 1.5 to 8.0 cm and a length to thickness ratio in the range 30 to 70, wherein at least part of the length of the wire element comprises a series of longitudinally consecutive portions 1 to 4 each of a length in the range 1 to 4 times the wire thickness and each translated laterally by cold shearing with respect to its neighbours by a distance in the range 0.1 to 0.3 times the wire thickness, adjacent ones of said portions being sheared in opposite directions 6 and 7 so that the wire is of double crenellated configuration when viewed laterally, with the protrusions on one side opposite to the indentations on the other side.

FIG.1



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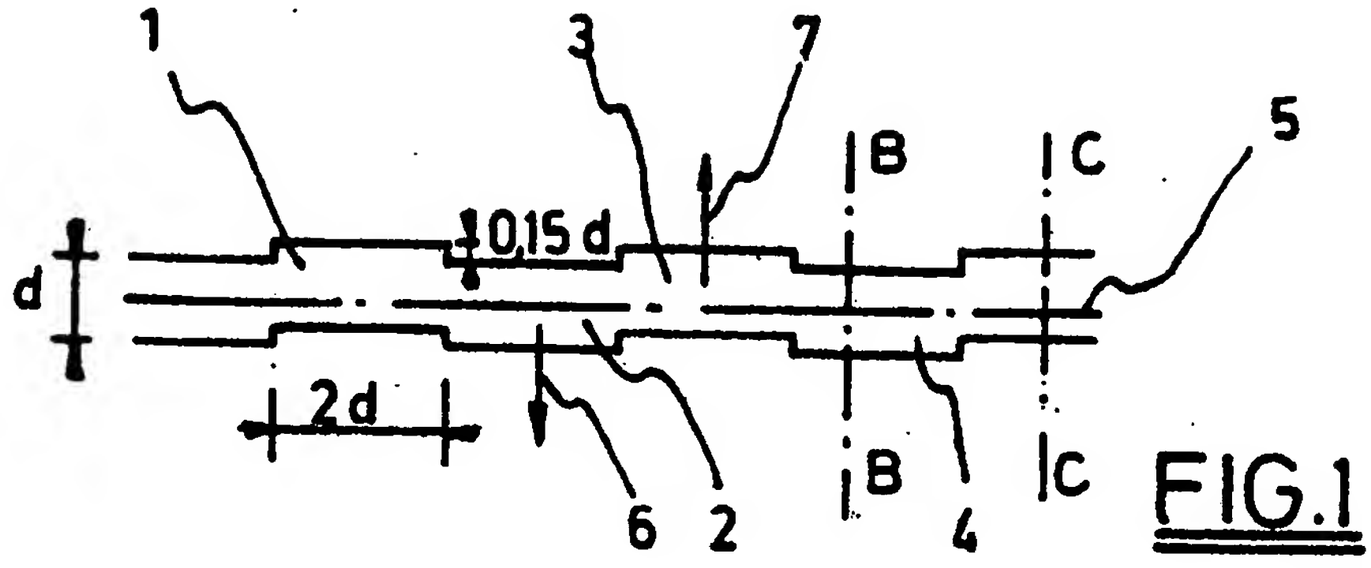

FIG.1

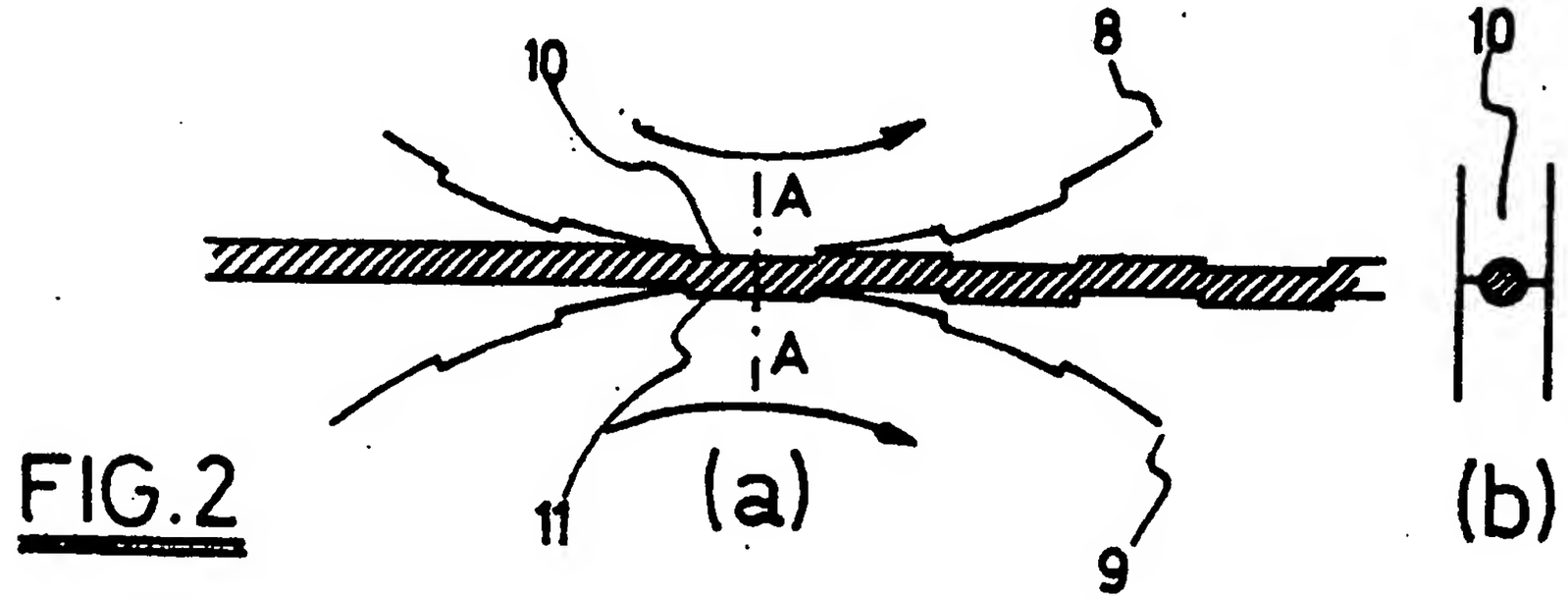

FIG.2

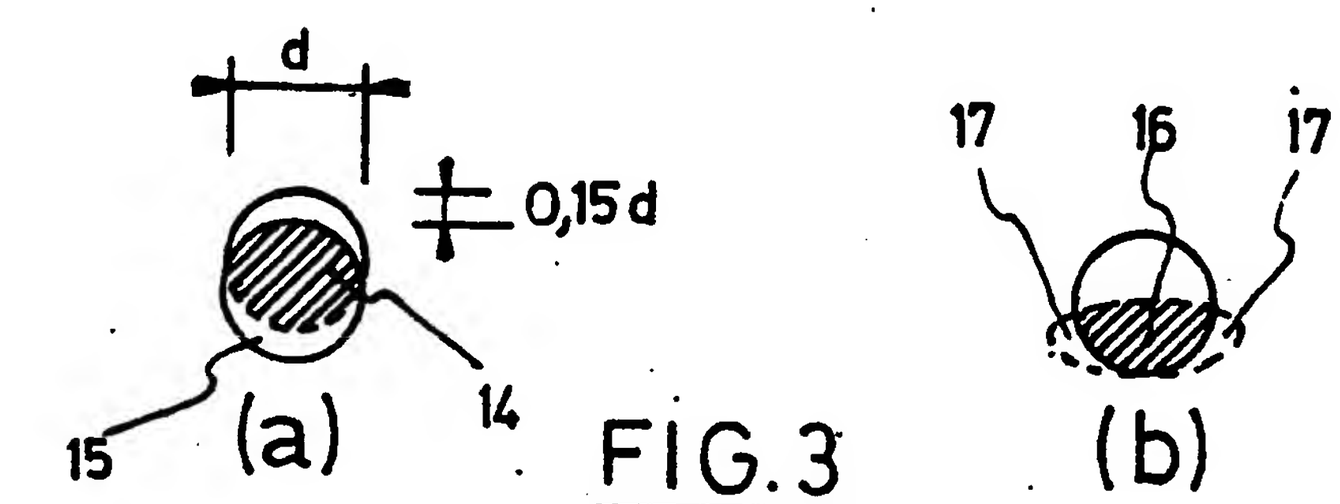

FIG.3

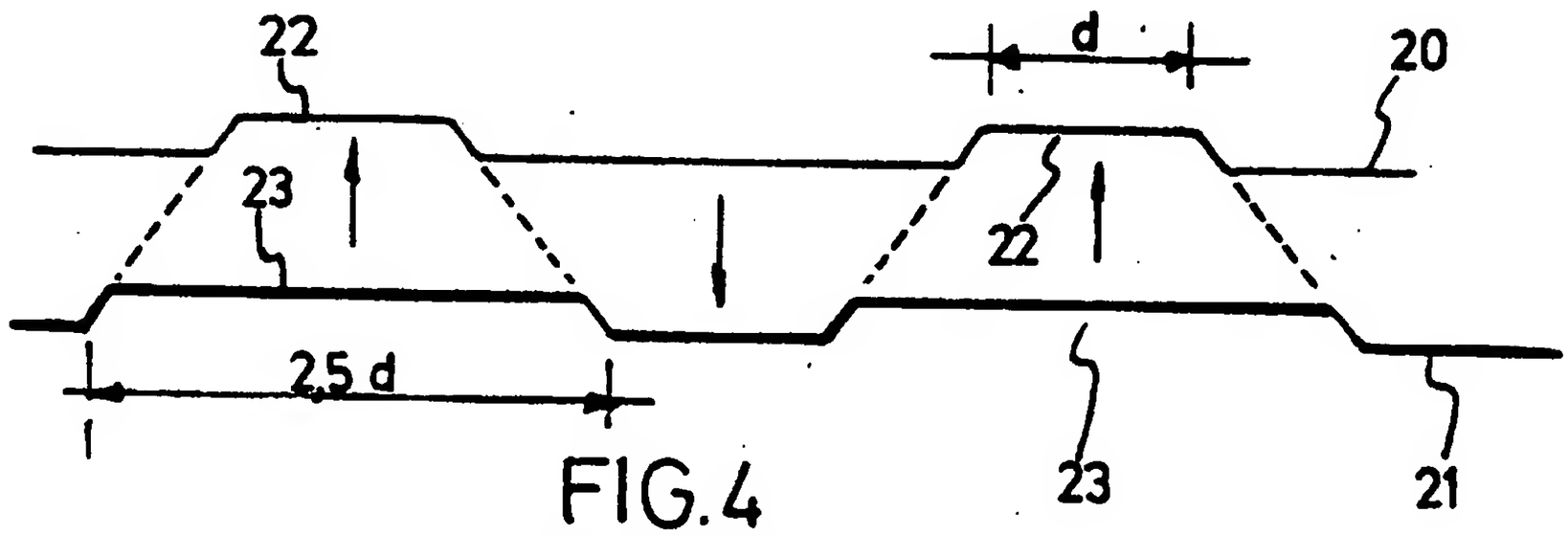

FIG.4

SPECIFICATION

Reinforcing mortar or concrete

The invention relates to steel wire elements for reinforcing mortar or concrete. Such wire elements are introduced in large quantities and mixed in mortar or concrete, and after hardening of the mortar or concrete they serve to increase the resistance to rupture of the mortar or concrete members.

In order to increase the reinforcing effect of the wire elements, it is customary to use them with a length-to-thickness ratio as high as possible, but here there are limitations, firstly in that the price of the wire increases as the wires become thinner, and secondly in that the mixability of the wire elements becomes less as the length-to-thickness ratio increases. This is the reason why up to now wire elements have been used with a length-to-thickness ratio as much as possible above 70 but not more than about 200, the ratio depending on the composition of the mortar or concrete and the method of mixing.

It is also possible to increase the reinforcing effect by making the elements with bent or wavy shapes, but these tend to be straightened by further loading after first crack of the concrete, and consequently have a lower contribution to load resistance after first crack.

It is therefore an object of the invention to provide wire elements which do not need to have a length-to-thickness ratio of more than 70, but rather in the range 30 to 70, and where the reinforcing effect is obtained by means other than a high length-to-thickness ratio, and which are also inexpensive and do not lead to serious mixing problems.

According to the invention there is provided a steel wire element for reinforcing mortar or concrete, having a length in the range 1.5 to 8.0 cm and a length to thickness ratio in the range 30 to 70, wherein at least part of the length of the wire element comprises a series of longitudinally consecutive portions each of a length in the range 1 to 4 times the wire thickness and each translated laterally by cold shearing with respect to its neighbours by a distance in the range 0.1 to 0.3 times the wire thickness, adjacent ones of said portions being sheared in opposite directions so that the wire is of double crenellated configuration when viewed laterally, with the protrusions on one side opposite to the indentations on the other side.

Preferably the said indentations are longer than the said protrusions. Preferably the said protrusions have a length in the range 0.8 to 1.5 times the wire thickness and the said indentations have a length in the range 1.5 to 3.0 times said thickness, and both the protrusions and the indentations have sloping end walls.

In order to increase the reinforcing effect of the wire elements it is necessary, in general, to take care that there is a good anchoring of the steel in the concrete. This can be achieved either by making the steel-to-concrete contact surface per unit weight of steel as high as possible by means of a high length-to-thickness ratio, or, as in the case of the present invention, by providing the wire element with surface irregularities for anchoring the steel in the concrete. It is however important that, as in the present invention, the right sort of surface irregularities are chosen. Unlike surface irregularities for thick concrete reinforcement rods, for steel wire element reinforcement there is here a specific problem. The maximum reinforcing effect of the wire elements is reached by increasing the surface irregularities until the chance of failure in bonding or anchoring becomes equal to the chance of failure in tensile strength. However, the surface irregularities must not be of a type that unduly decreases the rupture strength, because then the gain in reinforcing effect is again lost.

Some embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is an axial cross-sectional view of part of the length of a steel wire element according to the invention;

Figure 2 shows how the cross-sectional shape of Figure 1 can be obtained by drawing the wire between two toothed wheels;

Figure 3*a* shows the shape of a wire element according to the invention, in transverse cross-section, compared with the shape of a wire element not according to the invention, illustrated in Figure 3*b*; and

Figure 4 shows the axial cross-sectional shape of a wire element according to a preferred embodiment of the invention.

Referring first to Figure 1, the wire element includes in its length a number of portions 1, 2, 3, 4 which are adjacent each other along the axis 5 of the wire element. Each portion has a length, i.e. the dimension in the direction of axis 5, which is equal to twice the thickness *d* of the wire. Portion 2 is translated laterally by cold shearing with respect to portion 1 in the direction of arrow 6, and portion 3 is similarly translated with respect to portion 2 in the direction of arrow 7. Both directions 6 and 7 lie in the plane of the drawing and are thus opposite to each other. The translation is about 0.15 times the thickness *d*.

The shearing can easily be effected by drawing the wire between two toothed wheels 8 and 9, as shown in Figure 2. The toothed wheels will of their own volition take up mutual positions in which minimum energy is needed to draw the wire between the wheels, this being the position in which the teeth 10 of wheel 8 are opposite the spaces 11 between the teeth of wheel 9. Then, when the wire is drawn between the wheels it is not bent or crimped but rather the consecutive wire portions are cold sheared with respect to each other.

Figure 2*b* shows a cross-section of the toothed wheels on line A—A of Figure 2*a*. There is no space between the wheels on each side of the wire-receiving gap so as to ensure that when the wire is sheared by tooth 10 any excess material is

not pushed sideways but is displaced into the opposite free space 11.

When cross-section C—C (Figure 1) is compared with cross-section B—B, as shown in full and dotted lines respectively in Figure 3*a*, it will be seen that there is a hatched common cross-section 14 remaining, through which tensile force can run continuously over the length of the wire element, and which provides the wire with sufficient tensile strength so long as the shearing translation is not too large, i.e. is not more than 0.3 times the wire thickness *d* (in the illustrated embodiment the translation is 0.15 times the thickness). The crescent-shaped protrusions 15 of the cross-section provide the anchoring effect, and for that reason the translation must not be too small, i.e. not less than 0.1 times the wire thickness. For other types of wire element which have longitudinally consecutive portions displaced laterally with respect to each other but which are not in accordance with the present invention, such as shown for example in Figure 3*b*, the common portion 16 of the cross-section is too small, so that too much tensile strength is lost and the laterally displaced parts 17 protrude too sharply, with the result that the anchoring is not sufficiently effective in proportion to the amount of material which has been displaced.

A preferred embodiment of the invention is seen in Figure 4. The cross-sectional shape, in the plane of the directions in which the cold shearing has taken place, has the form of two parallel crenellated lines 20 and 21, with the protrusions 22 of one line 20 opposite to the indentations 23 of the other line 21, and conversely. The protrusions 22 have a length *d* between 0.8 and 1.5 times the wire thickness (in the drawing being equal to the thickness) and the indentations 23 have a length *d* of 1.5 to 3 times the wire thickness (in the drawing 2.5 times), whilst both the protrusions and the indentations have sloping end walls. This shape can be obtained by a modified form of the toothed wheels shown in Figure 2. In the example of Figure 4, the wire element has a length of 4 cm and a thickness of 0.8 mm.

CLAIMS

1. A steel wire element for reinforcing mortar or concrete, having a length in the range 1.5 to 8.0 cm and a length to thickness ratio in the range 30 to 70, wherein at least part of the length of the wire element comprises a series of longitudinally consecutive portions each of a length in the range 1 to 4 times the wire thickness and each translated laterally by cold shearing with respect to its neighbours by a distance in the range 0.1 to 0.3 times the wire thickness, adjacent ones of said portions being sheared in opposite directions so that the wire is of double crenellated configuration when viewed laterally, with the protrusions on one side opposite to the indentations on the other side.

2. A steel wire element as claimed in claim 1, wherein the said indentations are longer than the said protrusions.

3. A steel wire element as claimed in claim 1 or 2, wherein the said protrusions have a length in the range 0.8 to 1.5 times the wire thickness and the said indentations have a length in the range 1.5 to 3.0 times said thickness and both the protrusions and the indentations have sloping end walls.

4. Steel wire elements for reinforcing mortar or concrete, substantially as hereinbefore described with reference to the accompanying drawings.

5. For use in reinforcing mortar or concrete, a multiplicity of steel wires elements as claimed in any of claims 1 to 4.

6. Mortar or concrete reinforced with steel wire elements as claimed in claim 5.

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